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PART V

AIRCRAFT GROUND-FLOTATION INVESTIGATION
PART V DATA REPORT ON TEST SECTION 4

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U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

TECHNICAL REPORT AFFDL-TR-66-43, PART V
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AIR FORCE FLIGHT DYNAMICS LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

AIRCRAFT GROUND-FLOTATION INVESTIGATION
PART V DATA REPORT ON TEST SECTION 4

W. BRABSTON and W. HILL, JR.

FOREWORD

The investigation described herein constitutes one phase of studies conducted during 1964 and 1965 at the U. S. Army Engineer Waterways Experiment Station (WES) under U. S. Air Force Project No. 410-A, MIPR No. AS-4-177, "Development of Landing Gear Design Criteria for the CX-HLS Aircraft." (The CX-HLS is now designated C-5A.) This program was sponsored and directed by the Landing Gear Group, Air Force Flight Dynamics Laboratory, Research and Technology Division, Mr. R. J. Parker, Project Engineer.

These tests were conducted by personnel of the WES Flexible Pavement Branch, Soils Division, Under the general supervision of Messrs. W. J. Turnbull, A. A. Maxwell, and R. G. Ahlvin, and the direct supervision of Mr. D. N. Brown. Other personnel actively engaged in this study were Messrs. C. D. Burns, D. M. Ladd, W. N. Brabston, A. H. Rutledge, H. H. Ulery, Jr., A. J. Smith, Jr., and W. J. Hill, Jr. This report was prepared by Messrs. Brabston and Hill.

Directors of WES during the conduct of this investigation and preparation of this report were Col. Alex G. Sutton, Jr., CE, and Col. John R. Oswalt, Jr., CE. Technical Director was Mr. J. B. Tiffany.

Publication of this technical documentary report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

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ABSTRACT

This data report describes work undertaken as part of an overall program to develop ground-flotation criteria for the C-5A aircraft. A test section was constructed to a width adequate for two test lanes. Each lane was divided into three items having different subgrade CBR values and different traffic surfaces. Item 1 was surfaced with modified T11 aluminum landing mat, item 2 with M8 steel mat, and item 3 remained unsurfaced. Traffic was applied to the lanes using a 70,000-lb load having different wheel assembly configurations. A single-tandem and a twin-wheel assembly were used on each of the two test lanes, respectively. Each assembly consisted of two 56x16, 24-ply aircraft tires spaced 60 in. c-c with inflation pressure of 100 psi.

This report presents the data collected on soil strengths, surface deformations and deflections, and drawbar pull. The traffic-coverage level at failure for each test item is also given.

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SUMMARY

Tests on Section 4 are one phase of a comprehensive research program to develop ground-flotation criteria for heavy cargo-type aircraft. Section 4 consisted of two similar traffic lanes, lanes 7 and 8, each of which was divided into three items (Fig 20). Each item was constructed to a different subgrade CBR value and had a different traffic surface. Item 1 was surfaced with modified T11 aluminum landing mat, item 2 with M8 steel landing mat, and item 3 remained unsurfaced.

Traffic was applied to lanes 7 and 8 using single-tandem and twin-wheel configurations, respectively. Wheel assembly load was 70,000 lb for both lanes. Each assembly consisted of two 56x16, 24-ply aircraft tires spaced 60 in. c-c and inflated to 100 psi. Fig 22 gives pertinent tire-print dimensions and tire characteristics. The lanes were trafficked to failure in accordance with the criteria designated in Part I of this report. Data were recorded throughout testing to give a behavior history of each item.

Using the test criteria mentioned above, it was possible to directly compare the effects of trafficking with the two assemblies. Basic performance data are summarized in the following paragraphs.

Lane 7

Item 1

Item 1 was considered failed due to roughness and mat breakage at 300 coverages. The rated CBR for the item was 2.1.

Item 2

Item 2 was considered failed due to roughness at 200 coverages. The rated CBR for the item was 4.9.

Item 3

Item 3 was considered failed due to excessive rutting at 100 coverages. Traffic was continued and data were recorded for postfailure coverages. The rated CBR for the item was 9.3.

Lane 8

Item 1

Item 1 was considered failed due to roughness at 460 coverages. The rated CBR for the item was 2.4.

Item 2

Item 2 was considered failed due to roughness at 142 coverages. The rated CBR for the item was 4.0.

Item 3

Item 3 was considered failed due to excessive rutting at 62 coverages. The rated CBR for the item was 9.8.

AIRCRAFT GROUND-FLOTATION INVESTIGATION

PART V DATA REPORT ON TEST SECTION 4

SECTION I: INTRODUCTION

The investigation reported herein is one phase of a comprehensive research program being conducted at the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., as part of U. S. Air Force Project 410-A, MIPR No. AS-4-177, to develop ground-flotation criteria for the C-5A, a heavy cargo-type aircraft. Specifically, the tests reported herein are part of a series of tests to determine the degree of interaction of the wheels of multiple-wheel landing-gear assemblies on landing mat and unsurfaced soils under various conditions of loading, and to compare the trafficking effects of equally loaded single-tandem and twin-wheel configurations.

Prosecution of this investigation consisted of constructing two similar traffic lanes and subjecting them to equal test loads with single-tandem and twin-wheel landing-gear assemblies, respectively.

This report presents a description of the test sec ion and wheel assemblies, and gives results of traffic. Equipment us ., types of data and method of recording them, and general test criteria are explained and illustrated in Part I of this report.

SECTION II: DESCRIPTION OF TEST SECTION AND LOAD VEHICLE

Description of Test Section

The test section (Fig 20) was constructed within a roofed area in order to allow control of the subgrade CBR (California Bearing Ratio) in the test items. Section 4 was laid out on the same site as Test Section 2 in this series (Part III). The underlying subgrade was undisturbed by tests on Section 2 so that only 1 ft of soil was excavated for construction of Section 4. The excavated area was backfilled in two lifts with a heavy clay soil (buckshot; classified as CH according to the Unified Soil Classification System) which had a plastic limit of 27, liquid limit of 58, and plasticity index of 31. Gradation and classification data for the subgrade material are given in Part I.

Two traffic lanes divided into three items each were constructed in the section. Different subgrade strengths were obtained in the items (Fig 20) by controlling the water content and compaction effort. Items 1 and 2 were surfaced with modified T11 aluminum and M8 steel landing mats, respectively (Fig 21). Item 3 remained unsurfaced. Landing mats used are described and illustrated in Part I.

Load Vehicle

The load vehicle is shown in Fig 2. . Load cart construction, details of linkage between the load compartment and prime mover, and method of applying load are presented in Part I. For trafficking lanes 7 and 8, the load compartment was weighted to produce a 70,000-lb load on the tracking wheels. A single-tandem wheel configuration and a twin-wheel assembly were used for trafficking lanes 7 and 8, respectively. Two 56x16, 24-ply, type VII aircraft tires spaced 60 in. c-c and inflated to 100 psi were used. Tire-print data and tire characteristics are given in Fig 22 .

SECTION III: APPLICATION OF TRAFFIC AND FAILURE CRITERIA

Application of Traffic

The load vehicle was operated to produce uniform traffic coverage on the test lanes. The load cart was driven forward and backward along the same track longitudinally along the test lane, then shifted laterally and the forward-backward operation repeated. Figure 1 shows the general method of applying uniform coverages on the test lanes. Typically, the lane widths were not exact multiples of the tracking tire widths and spacings so that it was necessary to determine a coverage factor for each lane to compensate for small overlaps or gaps in the coverage pattern. In all cases, the coverage levels indicated in the text and on the data sheets represent the coverage levels determined in this fashion.

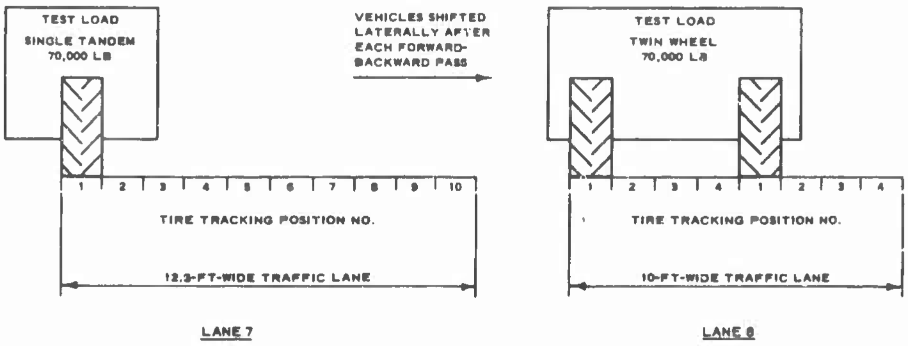


Figure 1. Sequence of traffic application for uniform coverages

Failure Criteria and Data Collected

Failure criteria used in this investigation and descriptive terms used in presentation and discussion of data in all reports in this series are presented in Part I. A general outline of types of data collected is given in the following paragraphs. Details on apparatus and procedure for obtaining specific measurements are given in Part I.

CBR, water content, and dry density

CBR, water content, and dry density of the subgrade were measured for each test item prior to application of traffic, at intermediate coverage levels, and at failure. After traffic was concluded on an item, a measure of subgrade strength termed "rated CBR" was determined. Rated CBR is generally the average CBR value obtained from all the determinations made in the top 12 in. of soil during the test life of an item. In certain instances, extreme or irregular values may be ignored if the analyst decides that they are not properly representative.

Surface roughness, or differential deformation

Surface roughness, or differential deformation, measurements were made using a 10-ft straightedge at various traffic-coverage levels on all items. Rut depths were measured for the unsurfaced item, and dishing effects of individual mat panels in the mat-surfaced items were recorded.

Deformations

Deformations, defined as permanent cumulative surface changes in cross section or profile of an item, were charted by means of level readings at pertinent traffic-coverage levels.

Deflection

Deflection of the test surface under an individual static load of the tracking assembly was measured at various traffic-coverage levels on both mat-surfaced and unsurfaced items. Level readings on the item surface on each side of the load wheels and on a pin and cap device directly beneath a load wheel provided deflection data. Both total (for a single loading) and elastic (recoverable) deflections were measured on items 2 and 3. All mat deflection was for practical purposes recoverable, i.e. total deflection equaled elastic deflection. The pin and cap device for measuring deflection directly beneath load wheels was applied to the subgrade of surfaced items through a hole (existing or cut) in the mat.

Rolling resistance

Rolling resistance, or drawbar-pull, measurements were performed with the load vehicle over each test item at designated coverage levels. Three types of drawbar measurements were taken: (a) maximum force required to overcome static inertia and commence forward movement of the load cart, termed "initial DBP"; (b) average force required to maintain a constant speed once the load vehicle is in motion, termed "rolling DBP"; and (c) maximum force obtained during the constant speed run, termed "peak DBP."

Mat breaks

Mat breaks on the surfaced items were inspected, classified by type, and recorded on the data sheet at various coverage levels.

SECTION IV: BEHAVIOR OF ITEMS UNDER TRAFFIC AND TEST RESULTS

Lane 7

Behavior of items under traffic

Item 1. **Fig 3** shows item 1 prior to traffic. The mat surface remained in excellent condition through 40 coverages and deteriorated gradually with trafficking thereafter. The item was considered failed due to roughness and mat deterioration at 300 coverages (**Figs 4** through **7**). At failure, many mat breaks and rivet failures were evident. The rated CBR of the item was 2.1.

Item 2. **Fig 8** shows item 2 prior to traffic. The M8 mat surface did not have a large number of breaks at 200 coverages when the item was considered failed due to roughness (**Figs 9** and **10**). At coverage levels near the failure point, the panel ends at the mat joint near the center line began to project upward (**Figs 9** and **10**). The rated CBR of the item was 4.9.

Item 3. Item 3 prior to traffic is shown in **Fig 11** . The item was in serviceable condition at 80 coverages, but had greatly deteriorated when data measurements were again taken at 128 coverages (**Fig 12**). After studying data collected at 128 coverages, it was decided to antedate the time of failure to 100 coverages. Failure was due to excessive rutting. The rated CBR of the item was 9.3.

Test results

Results of trafficking lane 7 are summarized in table 1. Soil test data are given in table 2. Table 1 also contains drawbar-pull values for the load vehicle operated over an asphalt-paved strip for comparison with drawbar values recorded on the test lane.

Item 1. Item 1 was considered failed due to roughness and mat deterioration at 300 coverages. The following information was obtained from traffic tests on item 1.

a. Roughness. Table 1 shows the steady increase in differential deformations with traffic coverages. At failure, average transverse and diagonal differential deformations were 2.75 and 2.16 in., respectively. Average transverse differential deformation was 2.75 in. Dishing effects of individual mat panels (table 1) averaged 0.48 in. at failure.

b. Deformation. **Figs 23** and **24** show average cross-sectional and profile deformations, respectively, for 40 and 300 coverages. Average cross-sectional measurements are shown for two typical

mat runs. The plots representing mat runs with joint located near the lane center line illustrate the tendency of the joint to deflect upward. On the adjacent runs where the midpoint of mat panel was located at center line of the traffic lane, the maximum deformation developed near the lane center line.

c. Deflection. Average elastic mat deflections under static load of the load vehicle (Fig 25) increased consistently with traffic coverages. Maximum deflection occurred with the panel joint at center line of the wheel assembly. Elastic subgrade deflection was not determined for the item.

d. Rolling resistance. Table 1 shows drawbar-pull values for several coverage levels. Initial and rolling drawbar-pull values increased to the 200-coverage level, then decreased slightly with additional trafficking. Peak drawbar values increased with the number of traffic coverages.

e. Mat breaks. Numerous mat breaks occurred in tracking the item to failure. Mat breaks were classified and recorded by type (table 1). An unusually severe mat failure occurred in run 4, panel 8, causing 6 in. of one end of the panel surface to tear loose and protrude upward at an angle of approximately 45 deg (Figs 4 and 5).

Item 2. Item 2 was considered failed due to roughness at 200 coverages. The following information was obtained from traffic tests on item 2.

a. Roughness. Differential deformations (table 1) show consistent increases with number of traffic coverages. At failure, average longitudinal, transverse, and diagonal differential deformations were 1.97, 1.89, and 2.65 in., respectively. The maximum average differential deformation was 2.65 in. diagonal. The average dishing measurement was 0.71 in. at failure.

b. Deformation. Permanent surface deformations are indicated in the cross-section and profile plots in Figs 23 and 24, respectively. Measurements taken at 40 and 200 coverages are represented. Average cross-sectional differential deformations are shown for both typical mat runs. Maximum average cross-sectional deformation was 1.2 in. at failure.

c. Deflection. Average elastic mat deflections under static load of the load vehicle are represented in Fig 25 for 0, 40, and 200 coverages. Deflections for three positions of the load vehicle relative to mat joint locations are plotted. Maximum deflection occurred with center line of the load assembly at the mat joint with an average of 2.4 in. Elastic subgrade deflections at 0 and 40 coverages were 0.6 and 0.8 in., respectively.

d. Rolling resistance. All drawbar-pull values given in table 1

show increases with trafficking. Rolling drawbar-pull values, however, increased only slightly.

e. Mat breaks. Mat breaks observed are given by type in table 1. Few breaks occurred in the M8 mat before the item failed.

Item 3. Item 3 was trafficked to 128 coverages at which time data measurements were taken. Study of the data indicated that the item was trafficked beyond the normal failure condition, and it was decided to predate the time of failure due to rutting at 100 traffic coverages. The following information was obtained from traffic tests on item 3.

a. Roughness. Table 1 lists the differential deformation measurements and rut depths for 40, 80, and 128 coverages. The average rut depth at 128 coverages was 5.75 in. Differential deformations in the longitudinal direction were slight, averaging 0.50 in. at 128 coverages.

b. Deformation. Average permanent soil cross-sectional and profile deformations at 40 and 128 coverages are plotted in Figs 23 and 24, respectively. Rutting and settlement of the item are seen to be far advanced at 128 coverages.

c. Deflection. Average total soil deflections are plotted in Fig 25. At 128 coverages a maximum average deflection of 1.8 in. is shown. Elastic soil deflections at 0, 40, and 128 coverages measured 0.3, 0.5, and 0.5 in., respectively.

d. Rolling resistance. All drawbar-pull values increased substantially over the trafficking period. Drawbar-pull values recorded at 0, 40, and 128 coverages are shown in table 1.

Lane 8

Behavior of items under traffic

Item 1. Item 1 is shown prior to traffic in Fig 13 The item held up well under traffic and did not have an excessive number of mat breaks at any time. Traffic was applied to the 460-coverage level when the item was considered failed due to roughness (Fig 14). The rated CBR for the item was 2.4.

Item 2. Fig 15 shows item 2 prior to traffic. On mat runs having the mat joint located near the lane center line, the panels deformed in a concave upward shape along their length causing the panel ends to extend upward at the joint. This condition contributed to transverse and diagonal roughness in the lane. No mat breaks occurred during testing. At 142 coverages the item was considered failed due to roughness (Figs 16 and 17). The rated CBR was 4.0.

Item 3. Item 3 prior to traffic is shown in Fig 18 . The item remained in good condition through 20 coverages with rut depths averaging 1.56 in. Continued trafficking resulted in progressive rutting and failure of the item at 62 coverages (Fig 19). The rated CBR for the item was 9.8.

Test results

Data recorded during trafficking of lane 8 are summarized in table 1. Soil test data for each item are given in table 2. Table 1 also shows drawbar-pull values for the load vehicle operated on an asphalt-paved strip for comparison with drawbar-pull values recorded on the test lane.

Item 1. Item 1 was considered failed due to roughness at 460 coverages. The following information was obtained from traffic tests on item 1.

a. Roughness. Table 1 shows the generally increasing magnitude of differential deformations with number of coverages. Roughness along the direction of traffic was not severe at any time, averaging less than 1.50 in. at failure. Average transverse and diagonal differential deformations were 2.20 and 1.71 in., respectively, at failure. Dishing averaged 0.56 in.

b. Deformation. Fig 23 shows average cross-sectional deformations for the item on each of two typical mat runs at 20, 320, and 460 coverages. On mat runs in which the panel spanned the entire lane width, maximum deformation occurred near the center of the lane. On the adjacent runs with a mat joint at the lane center line, maximum deformation occurred about 2 ft on each side of the joint. Center-line profiles in Fig 24 for 20 and 460 coverages show the general subsidence of the traffic lane and reflect the slightly elevated center-line joints of alternate mat runs.

c. Deflection. Average elastic mat deflections measured at 0, 20, and 460 coverages are plotted in Fig 25 for three positions of wheel assembly relative to mat panel joints.

d. Rolling resistance. Drawbar-pull values for several coverage levels are given in table 1. Maximum values of initial and rolling drawbar-pull values were recorded at 62 coverages. Peak drawbar-pull value was greatest at 460 coverages.

e. Mat breaks. Deterioration of the T11 mat on item 1 was relatively slight at failure compared with the corresponding item in lane 7. Table 1 shows breaks classified by type for numerous intermediate coverage levels and at failure of the item.

f. Mat embedment. In the early stages of trafficking, the mat

was fully embedded in the subgrade. However, during testing the soil entrapped between the tees on the underside of the mat separated from the subgrade. In an area along the lane center line the mat was bridging the subgrade during the latter part of the test, except when under direct loading.

Item 2. The item was considered failed due to roughness at 142 coverages. The following information was obtained from traffic tests on item 2.

a. Roughness. Differential deformations for several coverage levels are shown in table 1. Development of roughness paralleled the increasing number of traffic coverages. The manner in which the panel end joints along the lane center line projected upward contributed to roughness effects. Also, in making differential deformation measurements at failure, it was decided that the close proximity of the panel end joints on both sides of the traffic lane in alternate mat runs (**Fig 21**) affected performance of the mat surface inside the lane and therefore these joint lines were included in roughness determinations. At failure, the average longitudinal, transverse, and diagonal differential deformations were 1.91, 3.10, and 2.94 in., respectively.

b. Deformation. Average cross-sectional deformations are represented in **Fig 23** for the two typical mat runs. Deformations recorded at 20 and 142 coverages are shown. Maximum deformations occurred along paths on both sides of the lane center line. The center-line profile plot in **Fig 24** illustrates the deflecting of panel end joints that developed with trafficking.

c. Deflection. Average elastic mat deflections are represented in **Fig 25** for 0, 20, and 142 coverages. Deflections are plotted for the load assembly at three positions relative to mat joint locations. Plots are erratic for center line of assembly at mat joint and at half point of panel, and show little change with trafficking. Deflections with the assembly center line at panel quarter point are more consistent. Elastic subgrade deflections are tabulated in table 1 for 0, 20, and 142 coverages.

d. Rolling resistance. Drawbar-pull values for several coverage levels are shown in table 1. Only small increases [illegible]awbar-pull values were recorded from 0 to 142 coverages.

e. Mat breaks. No mat breaks were observed in the ite[illegible]ailure.

Item 3. Item 3 was considered failed due to excessive rutting at 62 coverages. The following information was obtained from traffic tests on item 3.

a. Roughness. Differential deformations and rut depths at 20 and 62 coverages are shown in table 1. At failure the average rut depth was 3.72 in.

b. Deformation. Average permanent soil deformations at 20 and 62 coverages are plotted in **Fig 23** and **24** for cross section and profile, respectively. The cross-section plot reflects a ridge down the lane center line, as shown in **Fig 19**. Measurements for the profile plot in **Fig 24** were made to one side of the center-line ridge to be more representative of the entire item.

c. Deflection. Average total soil deflections under static load of the load wheels are plotted in **Fig 25** for 0, 20, and 62 coverages. Increasing deflections were consistent with increasing number of coverages. Maximum average deflection was 2.3 in. at failure of the item. Elastic subgrade deflections are shown in table 1 and reached 0.5 in. at failure.

d. Rolling resistance. Drawbar-pull values are given in table 1. Rolling drawbar-pull values increased with increasing traffic coverages. Initial and peak values measured were slightly inconsistent with number of traffic coverages.

SECTION V: PRINCIPAL FINDINGS

From the foregoing discussion, the principal findings relating test load, wheel assembly, tire inflation pressure, surface type, subgrade CBR, and traffic coverages are as follows:

Load, Wheel Assembly, and Tire Pressure	Type of Surface	Rated Subgrade CBR	Coverages at Failure
70,000-lb load; single-tandem assembly (60 in. c-c); 56x16, 24-ply tires inflated to 100 psi	Modified T11 aluminum mat	2.1	300
	M8 steel mat	4.9	200
	Unsurfaced	9.3	100
70,000-lb load; twin-wheel assembly (60 in. c-c); 56x16, 24-ply tires inflated to 100 psi	Modified T11 aluminum mat	2.4	460
	M8 steel mat	4.0	142
	Unsurfaced	9.8	62

TABLE 1

SUMMARY OF TRAFFIC DATA, TEST SECTION 4

Test Item	Traffic Coverages	Rated CBR	No. of Mat Breaks* A	B	C	D	E	Differential Deformations (in.) Longitudinal Max	Longitudinal Avg	Transverse Max	Transverse Avg	Diagonal Max	Diagonal Avg	Dishing or Rutting (in.) Max	Dishing or Rutting (in.) Avg	Drawbar Pull (kips) Initial	Peak	Rolling	Average Total Deflection (in.) with Center Line of Wheel Assembly Located on: Unsurfaced Item Max	Unsurfaced Item Center Line of Assembly	Quarter Point of Panel Max	Quarter Point of Panel Center Line of Assembly	Half Point of Panel Max	Half Point of Panel Center Line of Assembly	Joint of Panel Max	Joint of Panel Center Line of Assembly	Elastic Subgrade Deflection (in.)	Remarks
																Lane 7												
1	0		--	--	--	--	--	--	--	--	--	--	--	--	--	5.9	4.2	2.5	--	--	--	1.2	--	1.3	--	1.5	--	Item failed at 300 coverages due to roughness and mat breakage
Modified T11 aluminum landing mat	40		--	7	--	--	--	1.13	0.84	0.75	0.56	1.38	0.88	0.50	0.40	6.6	5.3	2.8	--	--	--	1.4	--	1.5	--	2.0	--	
	80		13	28	--	--	--	1.38	0.88	0.88	0.70	1.50	1.20	0.50	0.45	--	--	--	--	--	--	--	--	--	--	--	--	
	120	2.1	19	60	--	--	--	1.63	1.05	1.13	0.95	1.38	0.88	0.50	0.45	--	--	--	--	--	--	--	--	--	--	--	--	
	160		27	111	--	--	--	1.63	0.97	1.25	1.00	1.50	1.43	0.50	0.45	--	--	--	--	--	--	--	--	--	--	--	--	
	200		28	120	--	--	--	1.63	1.05	1.38	0.98	1.88	1.60	0.50	0.45	9.0	5.2	3.4	--	--	--	--	--	--	--	--	--	
	240		32	178	1	2	--	1.63	1.09	1.50	1.23	1.63	1.42	0.50	0.45	--	--	--	--	--	--	--	--	--	--	--	--	
	300		32	213	12	3	3	2.00	1.37	4.00	2.75	2.38	2.16	0.63	0.48	8.1	5.6	3.2	--	--	--	1.6	--	1.6	--	2.7	--	
2	0		--	--	--	--	--	--	--	--	--	--	--	--	--	6.1	4.4	2.1	--	--	--	0.8	--	0.9	--	1.1	0.6	Item failed at 200 coverages due to roughness
M8 steel landing mat	40		--	--	--	--	--	1.63	1.55	1.13	0.96	1.30	1.27	0.50	0.40	6.5	4.5	2.6	--	--	--	0.9	--	1.5	--	2.0	0.8	
	80	4.9	11	--	--	--	--	1.75	1.67	1.50	1.23	1.75	1.58	0.63	0.53	--	--	--	--	--	--	--	--	--	--	--	--	
	120		12	--	6	--	--	2.00	1.69	1.50	1.41	1.75	1.60	0.63	0.48	--	--	--	--	--	--	--	--	--	--	--	--	
	160		12	--	8	--	--	2.25	1.96	2.00	1.56	2.88	2.45	0.63	0.63	--	--	--	--	--	--	--	--	--	--	--	--	
	200		12	9	9	--	--	2.38	1.97	2.13	1.89	3.00	2.65	1.13	0.71	8.2	5.5	2.7	--	--	--	1.0	--	1.6	--	2.4	--	
3	0		--	--	--	--	--	--	--	--	--	--	--	--	--	6.4	4.0	2.3	--	0.9	--	--	--	--	--	--	0.3	Item failed at 100 coverages due to excessive rutting. Traffic continued to 128 coverages.
Unsurfaced	40	9.3	--	--	--	--	--	0.25	0.25	2.50	1.21	1.60	1.05	2.13	1.71	6.7	5.0	3.7	--	1.1	--	--	--	--	--	--	0.5	
	80		--	--	--	--	--	0.50	0.38	3.00	1.84	2.25	1.81	4.25	1.36	--	--	--	--	--	--	--	--	--	--	--	--	
	128		--	--	--	--	--	0.75	0.50	6.25	4.89	4.75	3.79	6.25	5.75	8.2	6.6	4.8	--	1.8	--	--	--	--	--	--	0.5	
Asphalt test strip	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.5	3.4	1.5	--	--	--	--	--	--	--	--	--	
																Lane 8												
1	0		--	--	--	--	--	--	--	--	--	--	--	--	--	9.5	7.1	3.0	--	--	1.6	0.9	2.3	1.1	1.8	1.1	--	Item failed at 460 coverages due to roughness
	20		--	--	--	--	--	1.63	1.10	0.75	0.50	1.38	1.03	0.63	0.59	10.2	5.9	3.3	--	--	1.9	0.9	2.0	1.3	1.7	0.8	--	
	62		--	2	--	--	--	1.50	1.16	1.00	0.81	1.50	1.25	0.75	0.69	13.7	8.2	4.2	--	--	--	--	--	--	--	--	--	
	100		3	4	--	--	--	1.38	1.02	1.25	1.13	1.25	1.19	0.75	0.54	--	--	--	--	--	--	--	--	--	--	--	--	
	142		7	6	--	--	--	1.38	1.13	1.50	1.35	1.38	1.07	0.75	0.60	9.8	8.2	4.0	--	--	--	--	--	--	--	--	--	
	200		13	8	--	--	--	1.50	1.00	1.75	1.57	1.50	1.15	0.75	0.44	--	--	--	--	--	--	--	--	--	--	--	--	
	250	2.4	15	11	6	--	--	1.50	1.20	2.00	1.81	1.63	1.41	0.50	0.50	--	--	--	--	--	--	--	--	--	--	--	--	
	300		16	12	7	--	--	1.63	1.28	2.25	1.91	1.75	1.59	0.75	0.56	--	--	--	--	--	--	--	--	--	--	--	--	
	320		16	22	9	--	--	1.63	1.25	2.25	1.91	1.88	1.66	0.50	0.48	--	--	--	--	--	--	--	--	--	--	--	--	
	350		16	25	12	--	--	1.75	1.33	2.25	1.98	1.50	1.35	0.50	0.50	--	--	--	--	--	--	--	--	--	--	--	--	
	400		18	25	14	--	--	1.75	1.41	2.38	2.04	2.00	1.77	0.75	0.52	--	--	--	--	--	--	--	--	--	--	--	--	
	430		18	29	16	--	--	1.75	1.35	2.50	2.13	2.00	1.63	0.63	0.54	--	--	--	--	--	--	--	--	--	--	--	--	
	460		19	30	16	--	--	1.88	1.46	2.63	2.20	2.00	1.71	0.75	0.56	10.7	9.0	3.9	--	--	2.9	1.5	2.2	1.8	2.7	2.1	--	
2	0		--	--	--	--	--	--	--	--	--	--	--	--	--	9.4	6.5	2.6	--	--	1.4	0.2	0.9	0.3	0.9	+0.5	0.8	Item failed at 142 coverages due to roughness
	20		--	--	--	--	--	1.00	1.00	1.13	0.97	0.88	0.78	0.37	0.28	8.9	8.3	2.5	--	--	1.5	+0.1	0.7	0.1	0.7	+0.2	0.8	
	62	4.0	--	--	--	--	--	0.88	0.81	1.25	1.00	1.00	0.84	0.50	0.44	9.8	6.6	3.0	--	--	--	--	--	--	--	--	--	
	100		--	--	--	--	--	1.50	0.97	2.00	1.70	2.00	1.44	0.25	0.25	--	--	--	--	--	--	--	--	--	--	--	--	
	142		--	--	--	--	--	2.13	1.91	3.50	3.10	3.50	2.94	0.50	0.38	10.0	7.9	3.4	--	--	2.7	+0.1	0.9	0.5	1.0	0.4	0.9	
3	0		--	--	--	--	--	--	--	--	--	--	--	--	--	9.7	10.1	3.7	0.8	0.1	--	--	--	--	--	--	0.3	Item failed at 62 coverages due to excessive rutting
	20	9.8	--	--	--	--	--	0.50	0.38	2.13	1.56	2.00	1.53	2.13	1.56	10.2	8.9	3.9	1.3	0.6	--	--	--	--	--	--	0.5	
	62		--	--	--	--	--	1.50	1.03	4.00	3.72	3.75	3.41	4.00	3.72	9.6	10.5	6.2	2.3	+0.3	--	--	--	--	--	--	0.5	
Asphalt test strip	--		--	--	--	--	--	--	--	--	--	--	--	--	--	8.8	3.2	1.7	--	--	--	--	--	--	--	--	--	

Note: A 70-kip load on single-tandem (60 in. c-c) and twin-wheel (60 in. c-c) assemblies was used for trafficking lanes 7 and 8, respectively. On the wheels were 56x16, 24-ply tires inflated to 100 psi.
* Break types are defined and illustrated in Part I.

TABLE 2

SUMMARY OF CBR, DENSITY, AND WATER CONTENT DATA, TEST SECTION 4

Test Item*	Type of Surface	Number of Traffic Coverages	Depth (in.)	CBR	Water Content (%)	Dry Density (lb/cu ft)	Remarks
			Lane 7				
1	Modified T11 aluminum landing mat	0	0	2.7	25.4	90.3	Item failed at 300 coverages due to roughness and mat breakage
			6	2.1	28.1	90.9	
			12	1.5	30.2	85.6	
			18	2.2	24.2	91.4	
		300	0	2.8	28.5	90.4	
			6	2.0	31.6	86.3	
			12	1.5	33.2	85.3	
			18	2.8	31.5	86.8	
2	M8 steel landing mat	0	0	5.4	22.8	94.9	Item failed at 200 coverages due to roughness
			6	4.2	29.1	89.2	
			12	4.5	23.3	94.5	
			18	4.9	26.3	93.6	
		200	0	4.9	29.2	91.5	
			6	4.5	28.0	92.6	
			12	6.0	28.4	92.5	
			18	8.0	28.5	91.2	
3	Unsurfaced	0	0	10.0	23.8	93.5	Item failed at 100 coverages due to excessive rutting. Traffic continued to 128 coverages.
			6	10.0	25.4	93.1	
			12	10.0	26.4	94.2	
			18	12.0	24.9	94.8	
		128	0	8.0	25.4	95.1	
			6	8.0	24.4	97.2	
			12	10.0	24.8	96.8	
			18	12.0	24.9	97.1	
			Lane 8				
1	Modified T11 aluminum landing mat	0	0	2.3	25.1	91.8	Item failed at 460 coverages due to roughness
			6	2.4	24.8	91.9	
			12	2.4	26.1	88.8	
			18	2.3	29.4	88.0	
		460	0	2.1	32.4	87.5	
			6	2.2	32.0	87.3	
			12	2.7	30.9	88.0	
			18	2.5	31.9	86.9	
2	M8 steel landing mat	0	0	4.3	28.1	90.4	Item failed at 142 coverages due to roughness
			6	4.0	28.0	91.4	
			12	3.3	28.9	90.4	
			18	3.6	28.0	90.3	
		142	0	4.3	27.8	92.3	
			6	4.2	28.7	90.8	
			12	4.1	27.9	92.6	
			18	6.1	26.5	93.3	
3	Unsurfaced	0	0	11.0	24.7	94.4	Item failed at 62 coverages due to excessive rutting
			6	9.0	23.4	91.9	
			12	13.0	25.2	93.8	
		62	0	8.0	23.1	96.4	
			6	9.0	22.2	98.4	
			12	9.0	22.2	98.2	
			18	10.0	20.9	97.6	

* Subgrade material was heavy clay (buckshot; classified as CH) in all items.

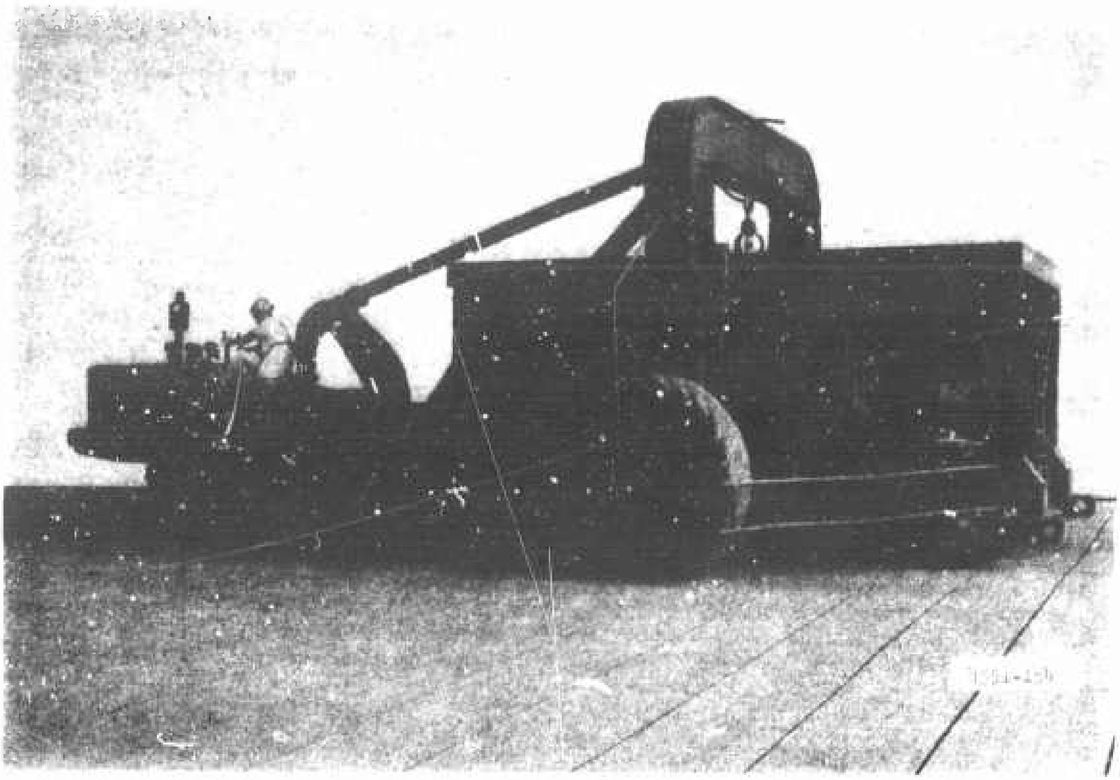


Fig 2.   Test load vehicle

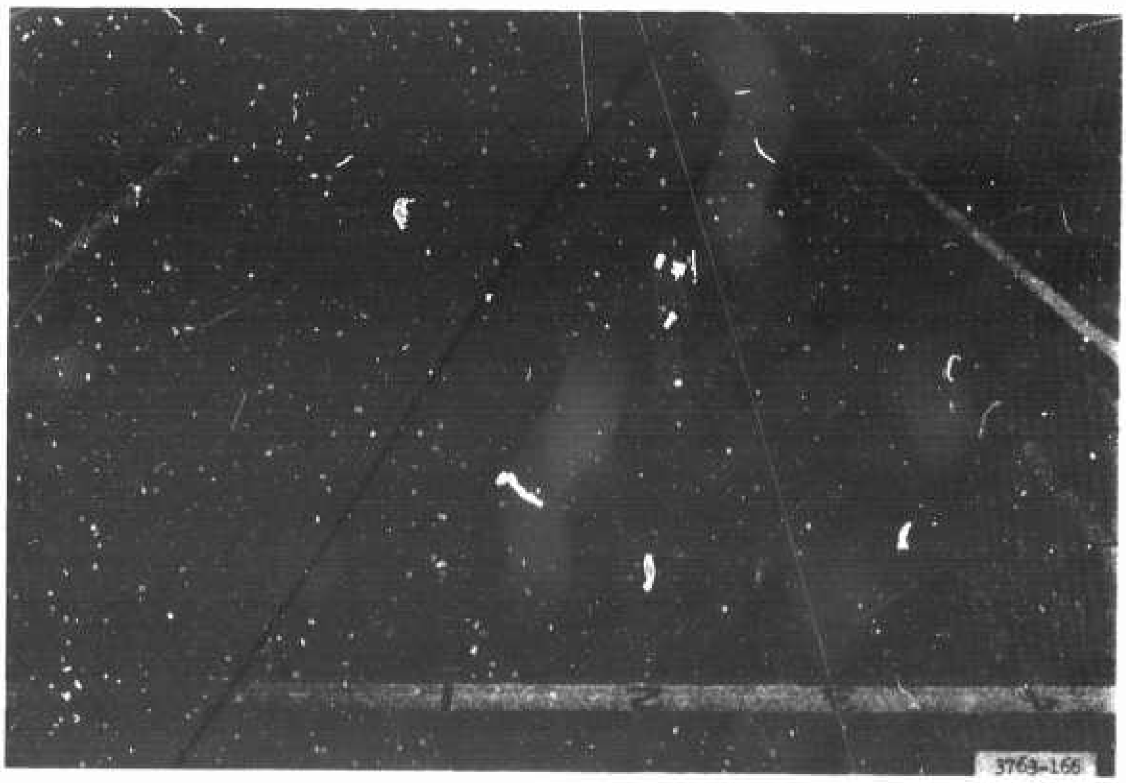


Fig 3. . Lane 7, item 1, prior to traffic

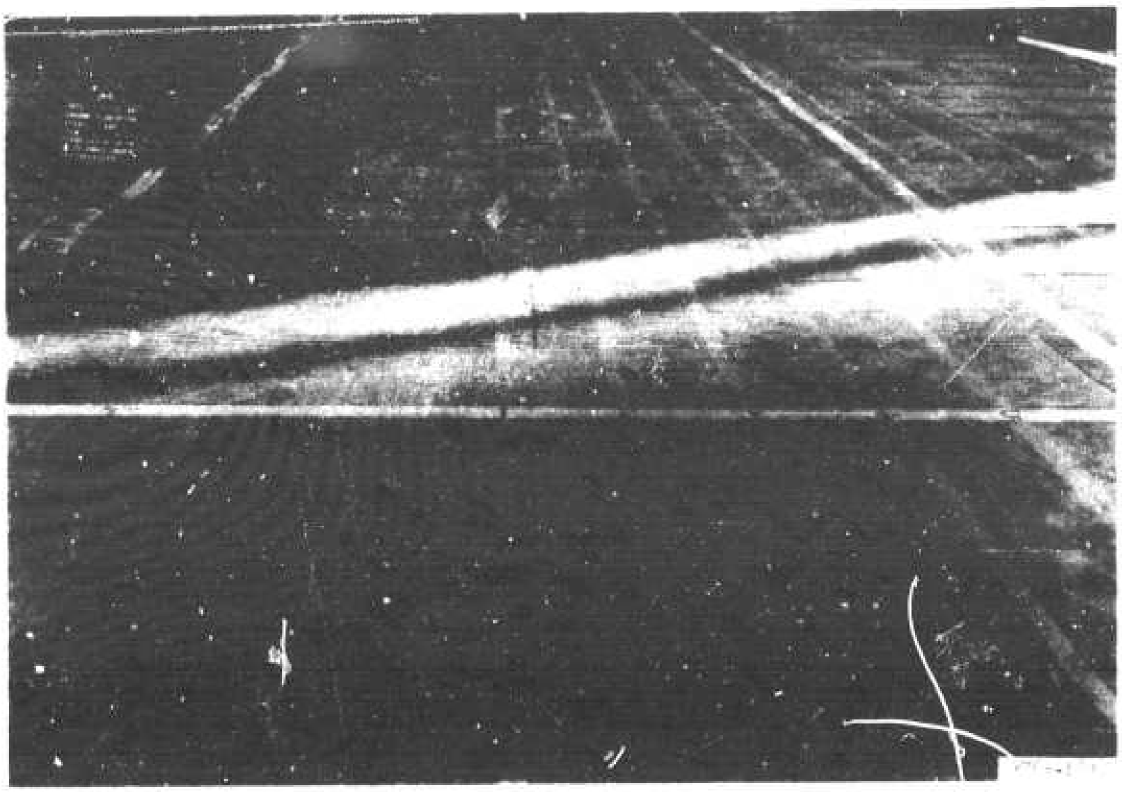


Fig 4. Lane 7, item 1; general view at 300 coverages (failure)

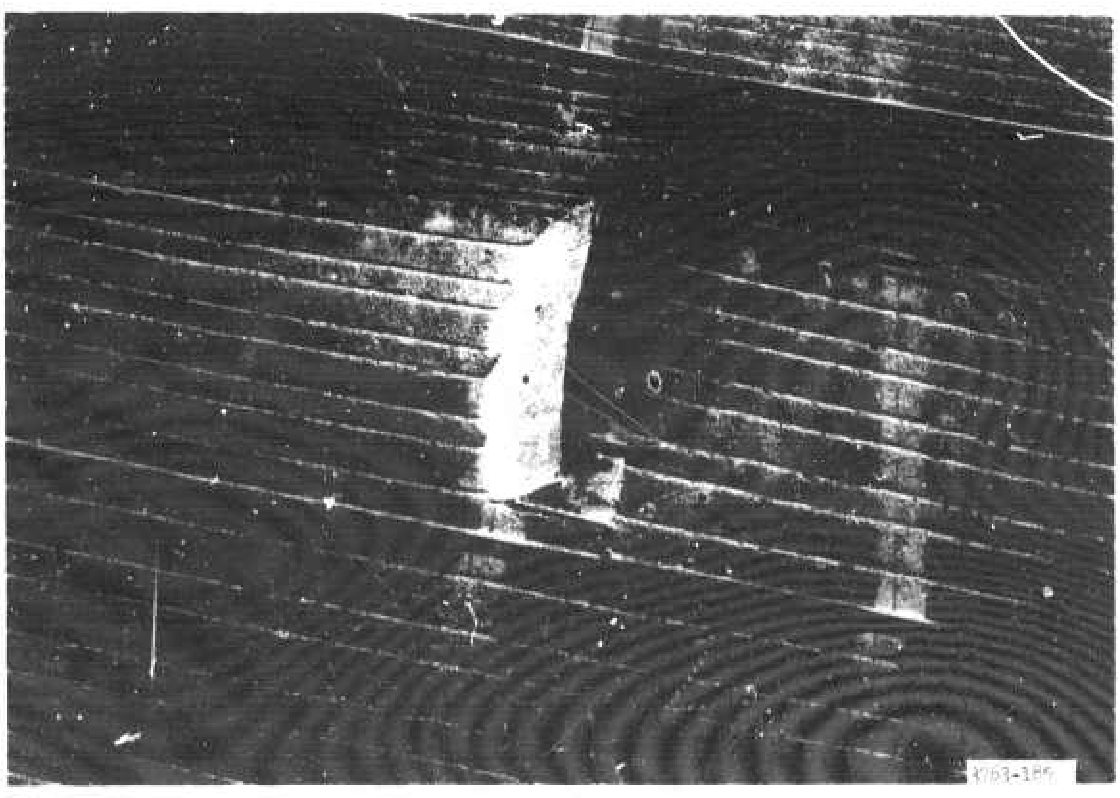


Fig 5. Lane 7, item 1; closeup view of severe mat break at 300 coverages (failure)

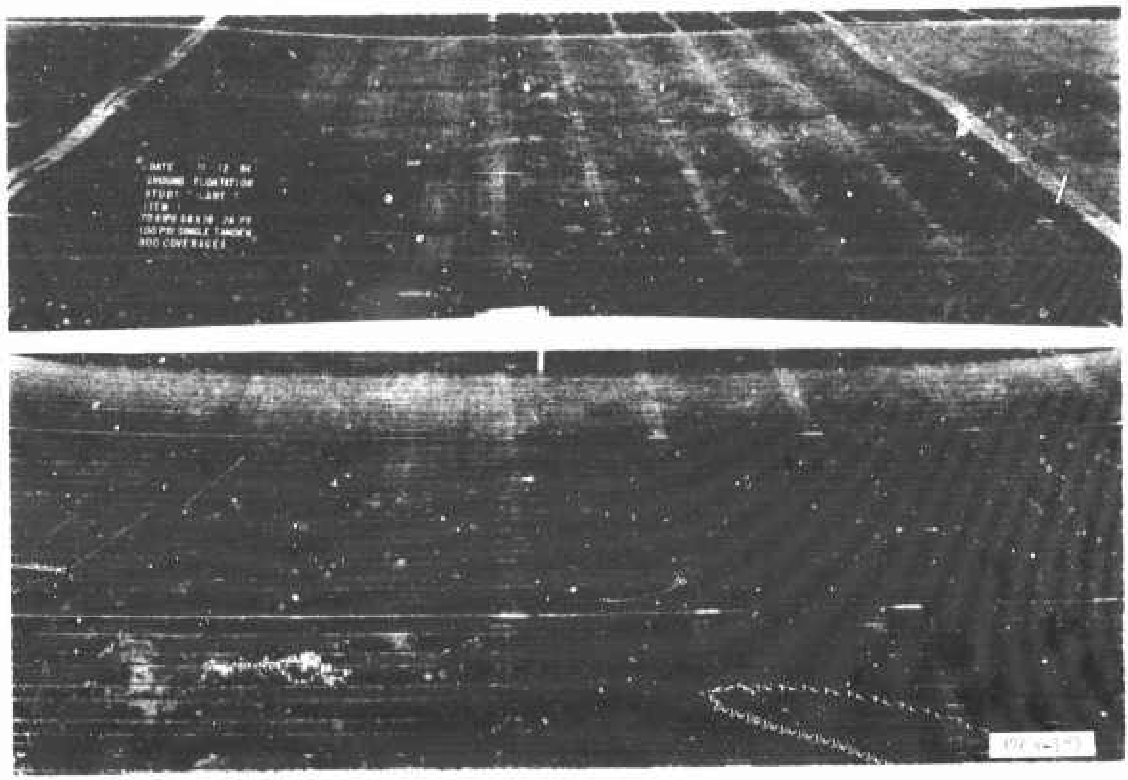


Fig 6. Lane 7, item 1. Transverse straightedge shows roughness at 300 coverages (failure)

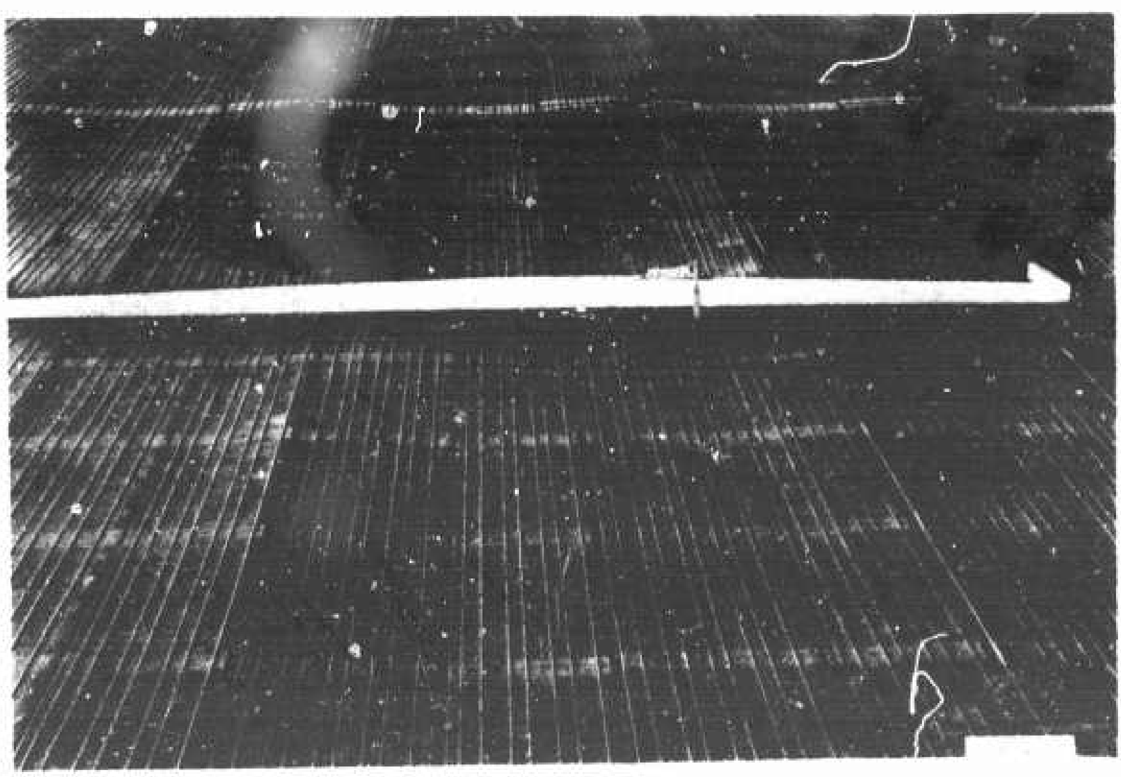


Fig 7. Lane 7, item 1. Longitudinal straightedge shows roughness at 300 coverages (failure)

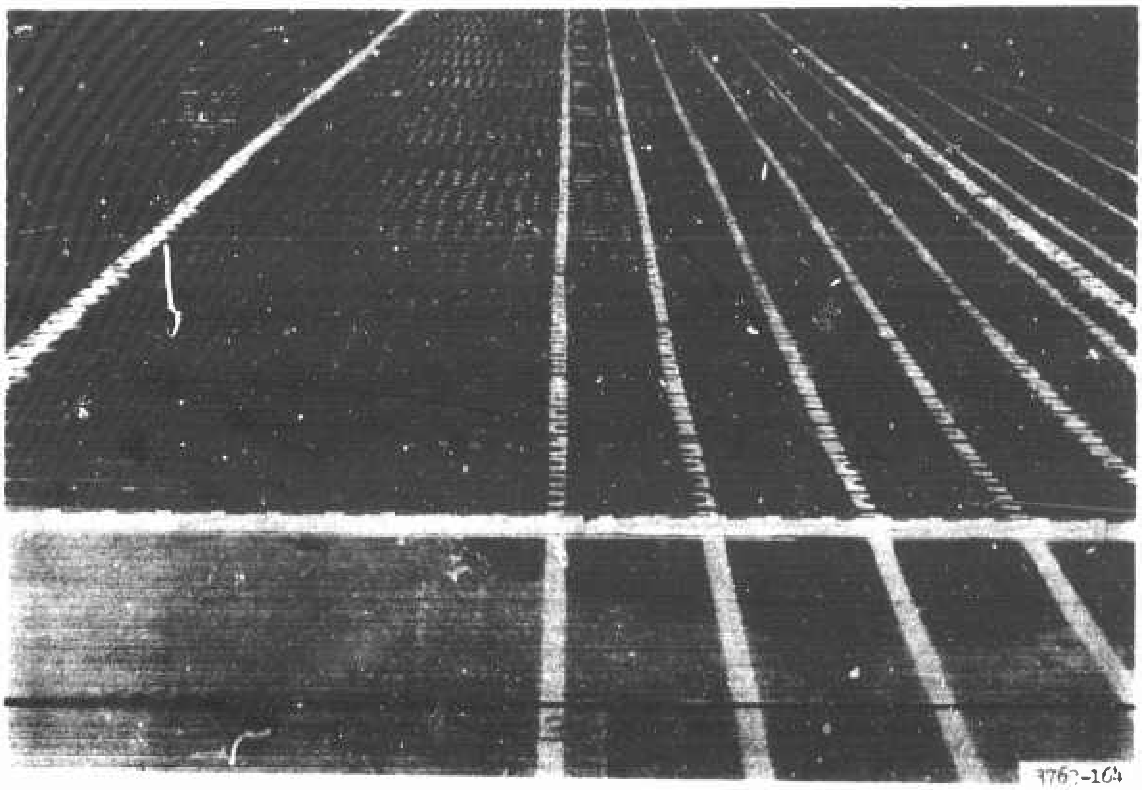


Fig 8. Lane 7, item 2, prior to traffic

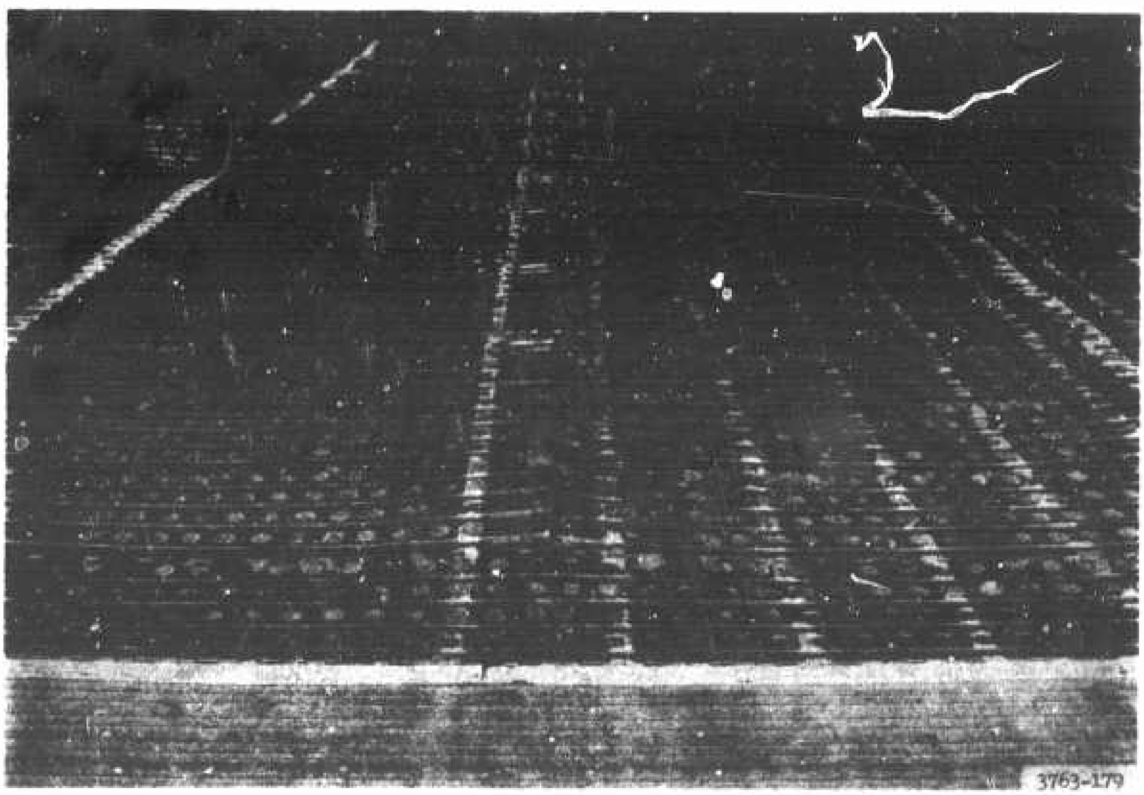


Fig 9. Lane 7, item 2; general view at 200 coverages (failure)

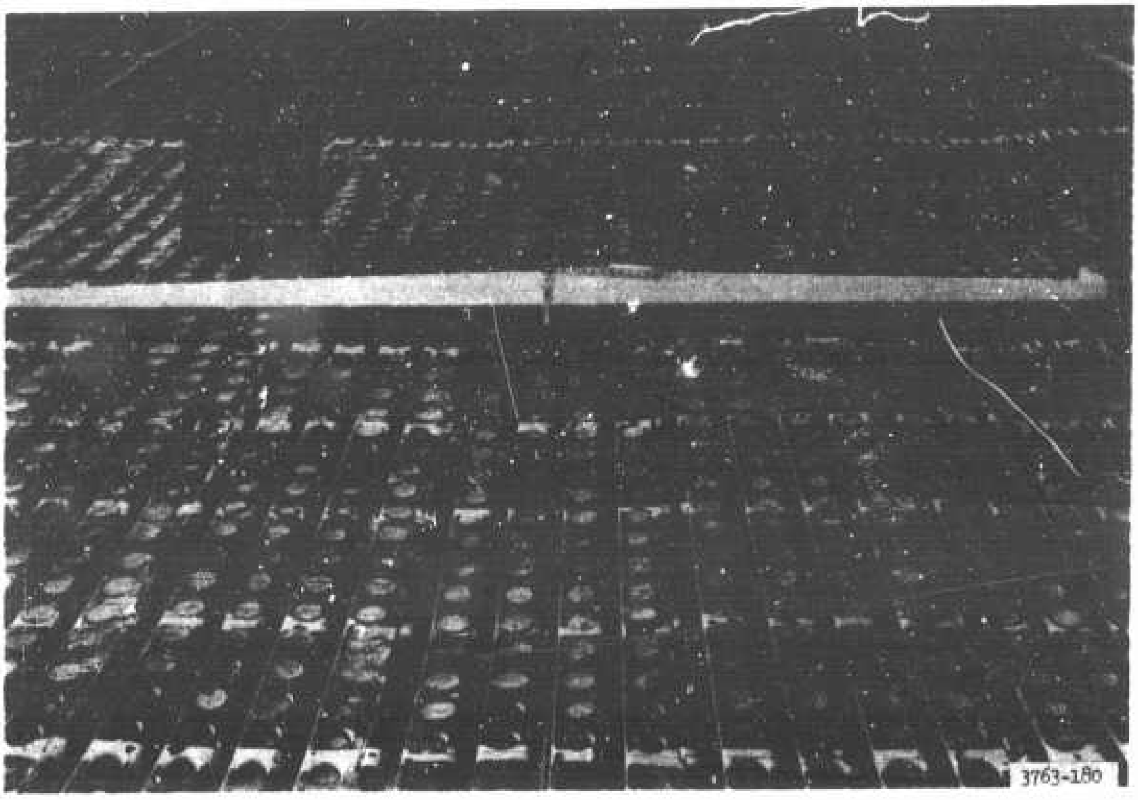


Fig 10. Lane 7, item 2. Longitudinal straightedge shows roughness along mat joint line at 200 coverages (failure)

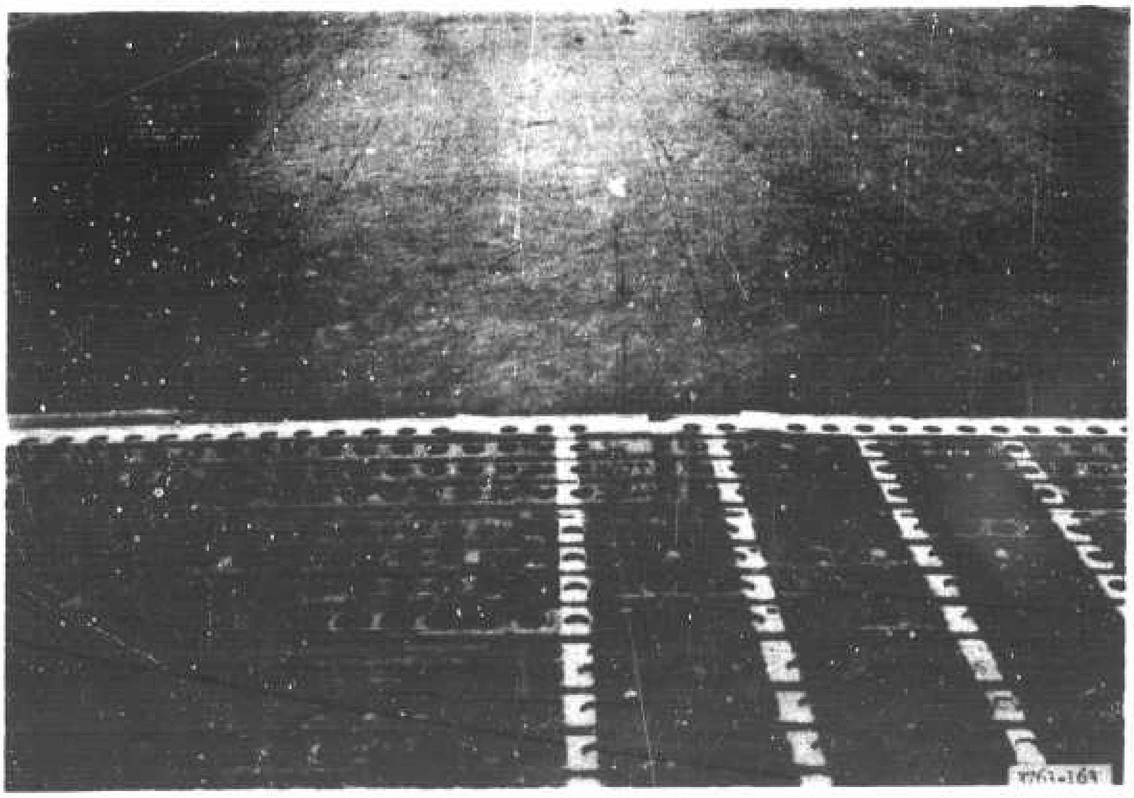


Fig 11. Lane 7, item 3, prior to traffic

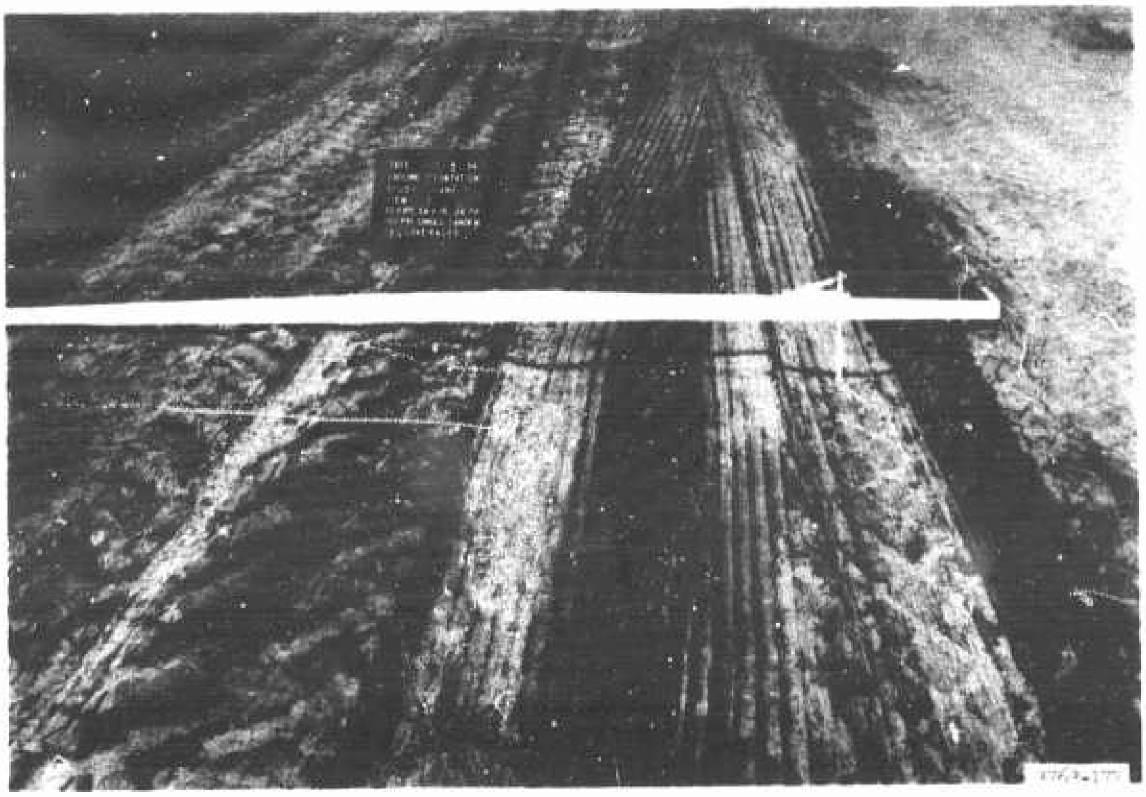


Fig 12. Lane 7, item 3. Transverse straightedge shows rutting at 128 coverages (28 postfailure coverages)

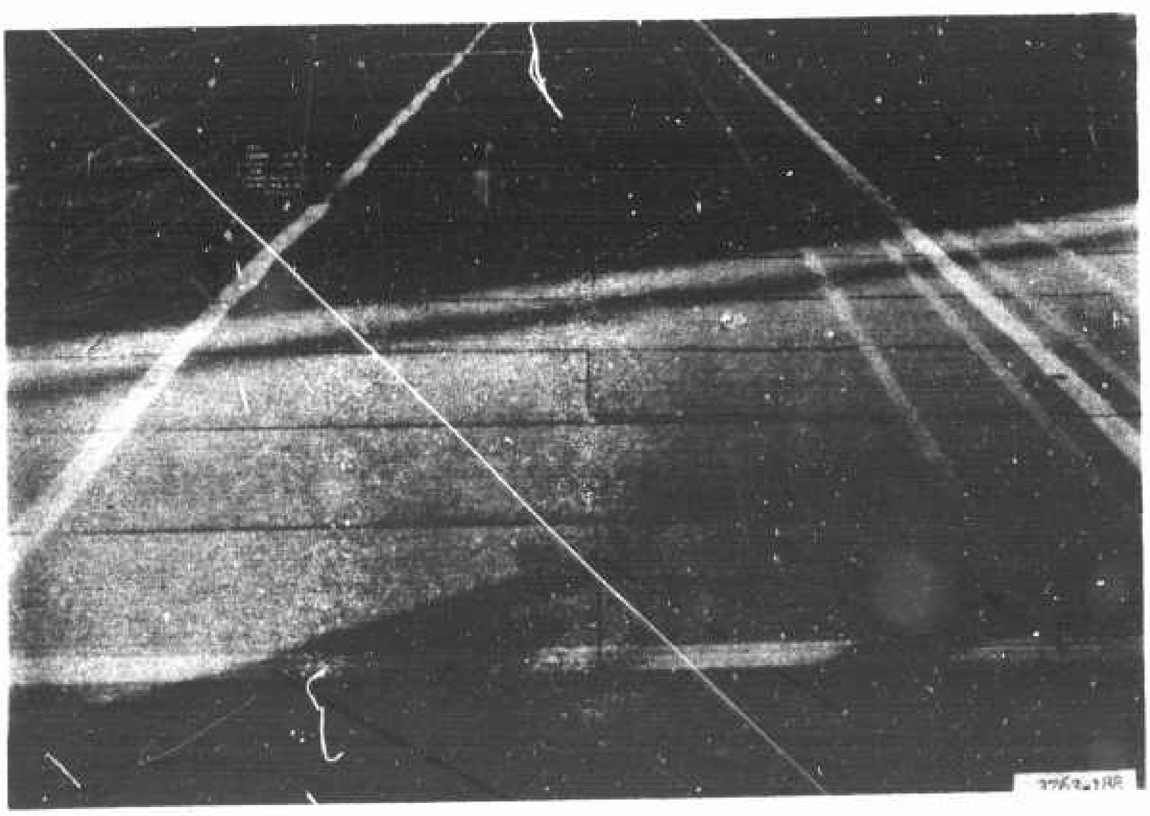


Fig 13. Lane 8, item 1, prior to traffic

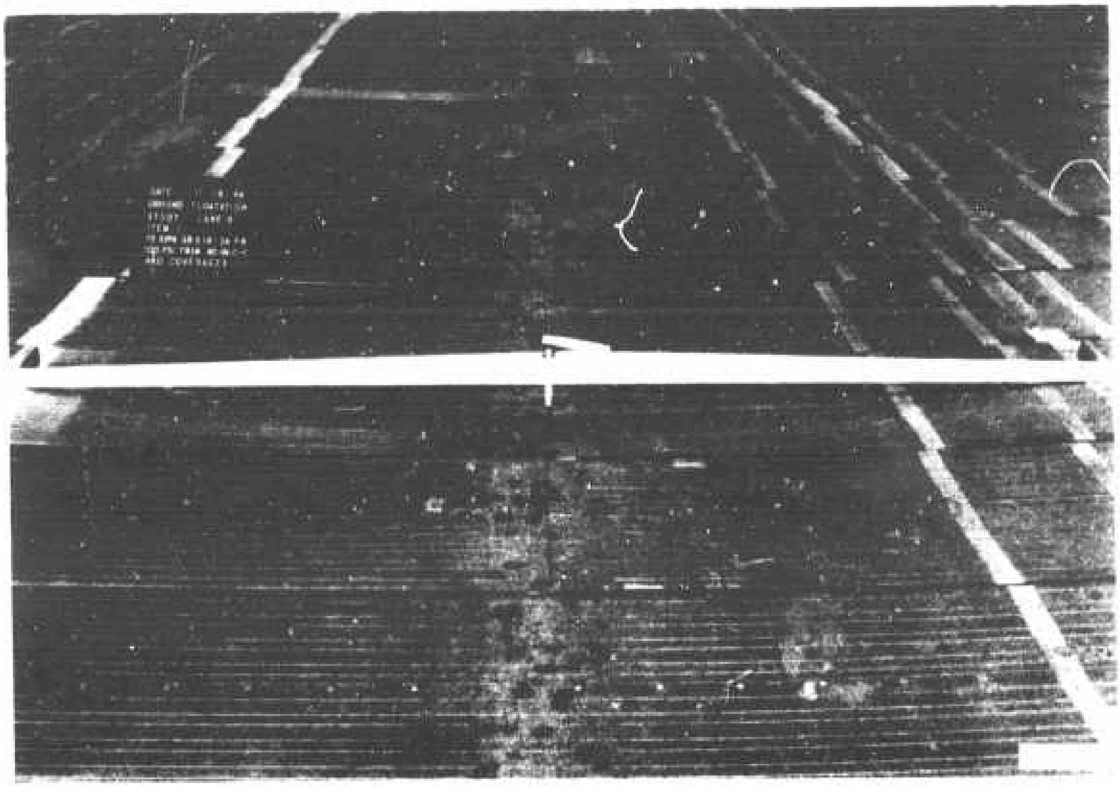


Fig 14. Lane 8, item 1. Transverse straightedge shows roughness at 460 coverages (failure)

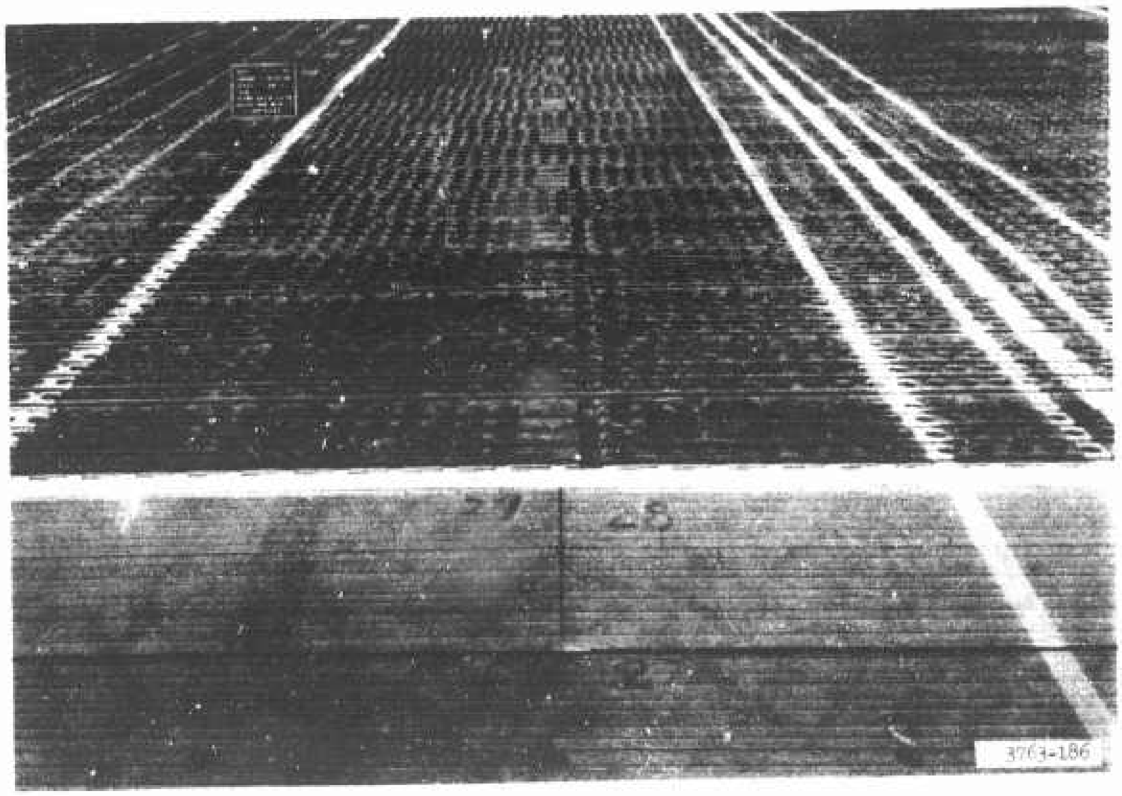


Fig 15. Lane 8, item 2, prior to traffic

Fig 16. Lane 8, item 2; general view at 142 coverages (failure)

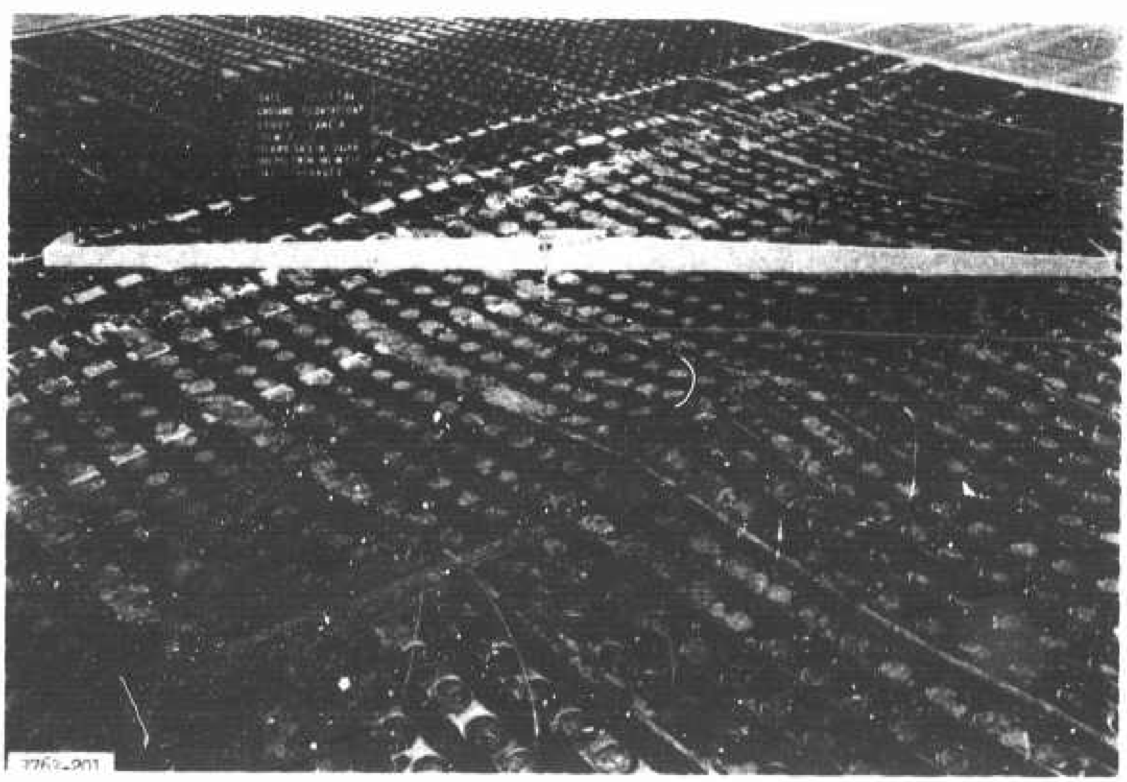


Fig 17. Lane 8, item 2. Diagonal straightedge shows roughness at 142 coverages (failure)

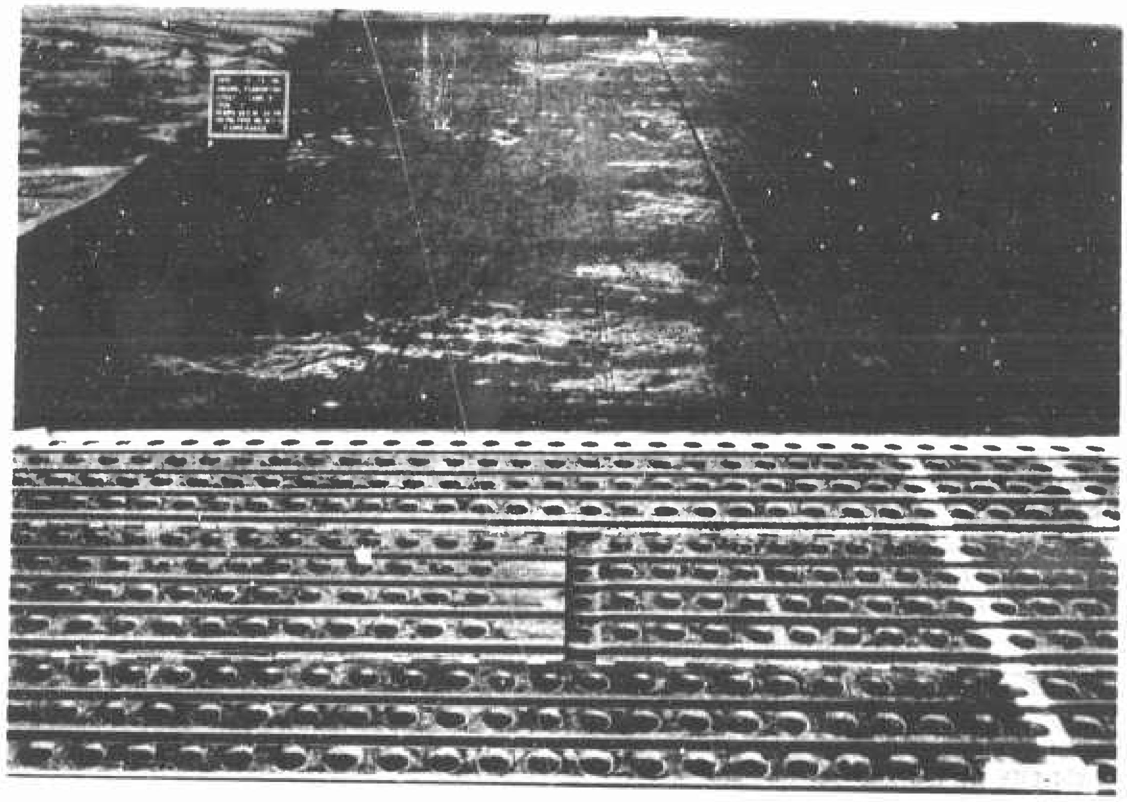


Fig 18. Lane 8, item 3, prior to traffic

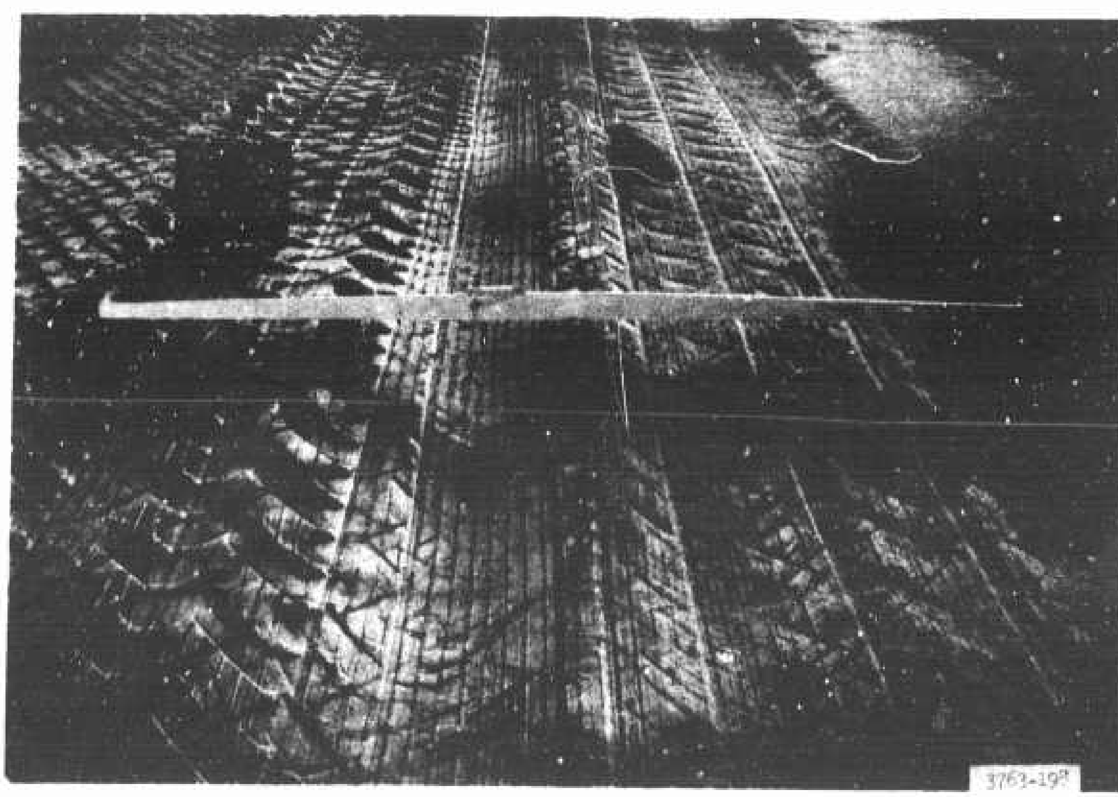
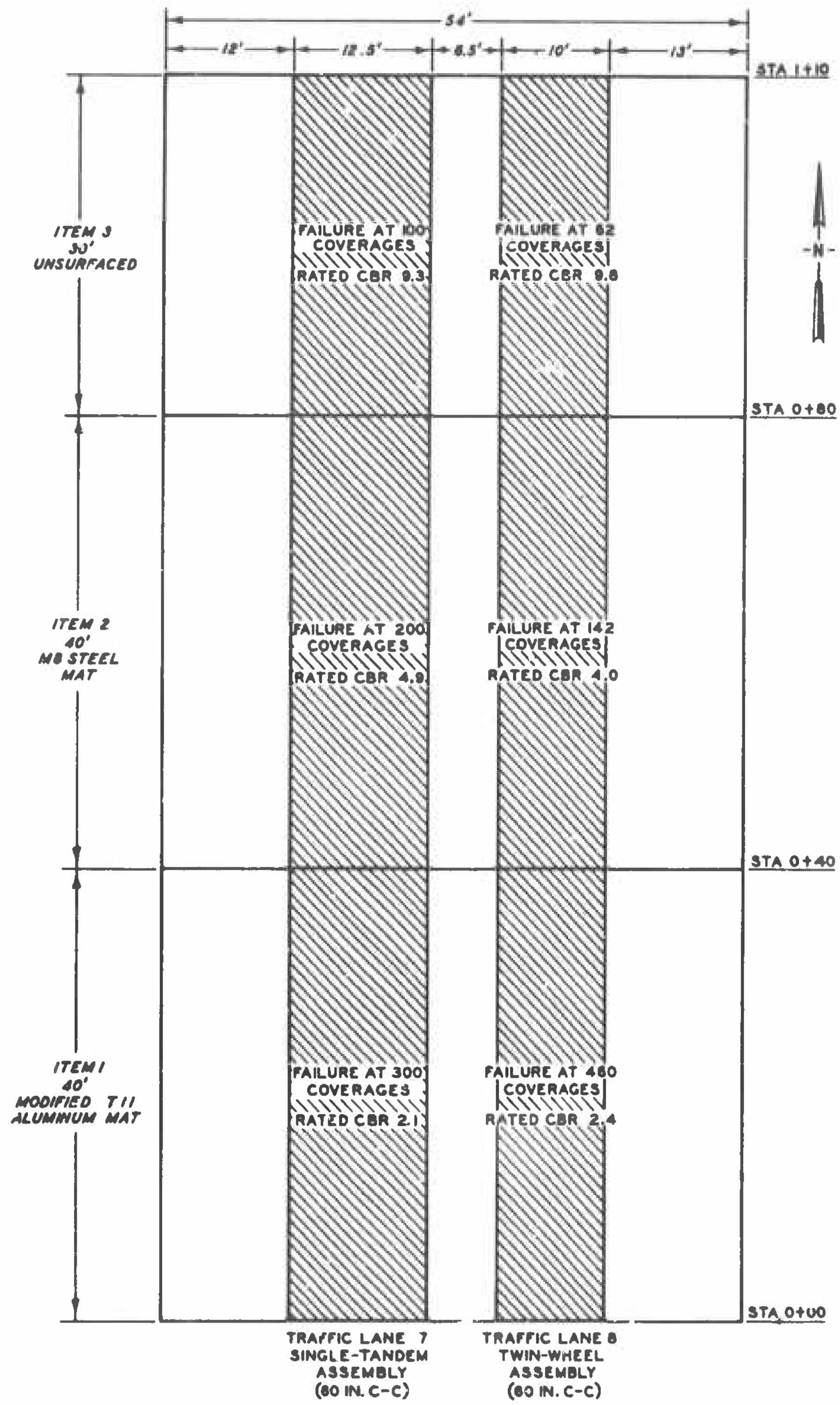


Fig 19. Lane 8, item 3. Transverse straightedge shows rutting at 62 coverages (failure)

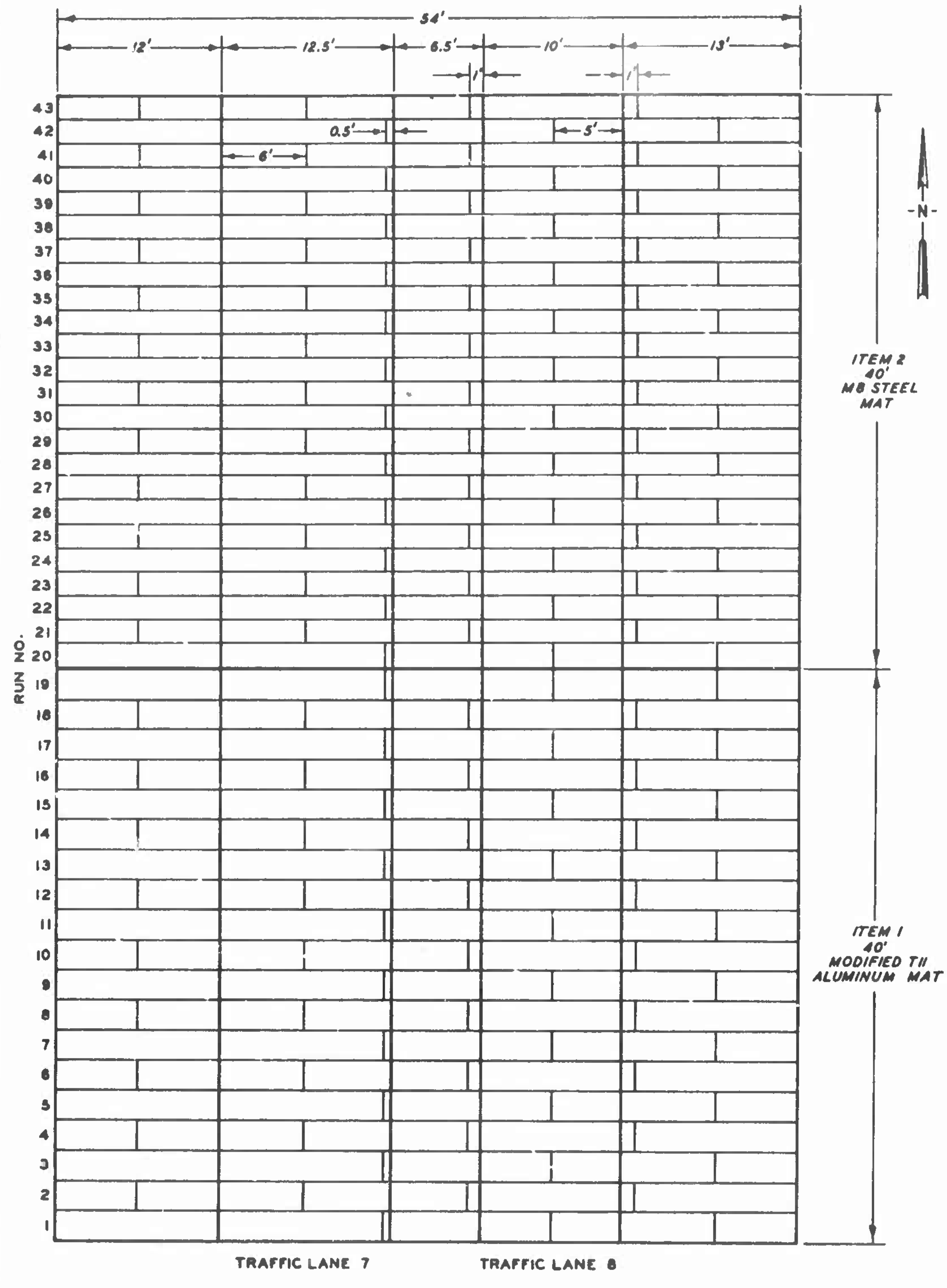


LAYOUT OF TEST SECTION 4
AND SUMMARY OF
TEST RESULTS

70,000-LB LOAD

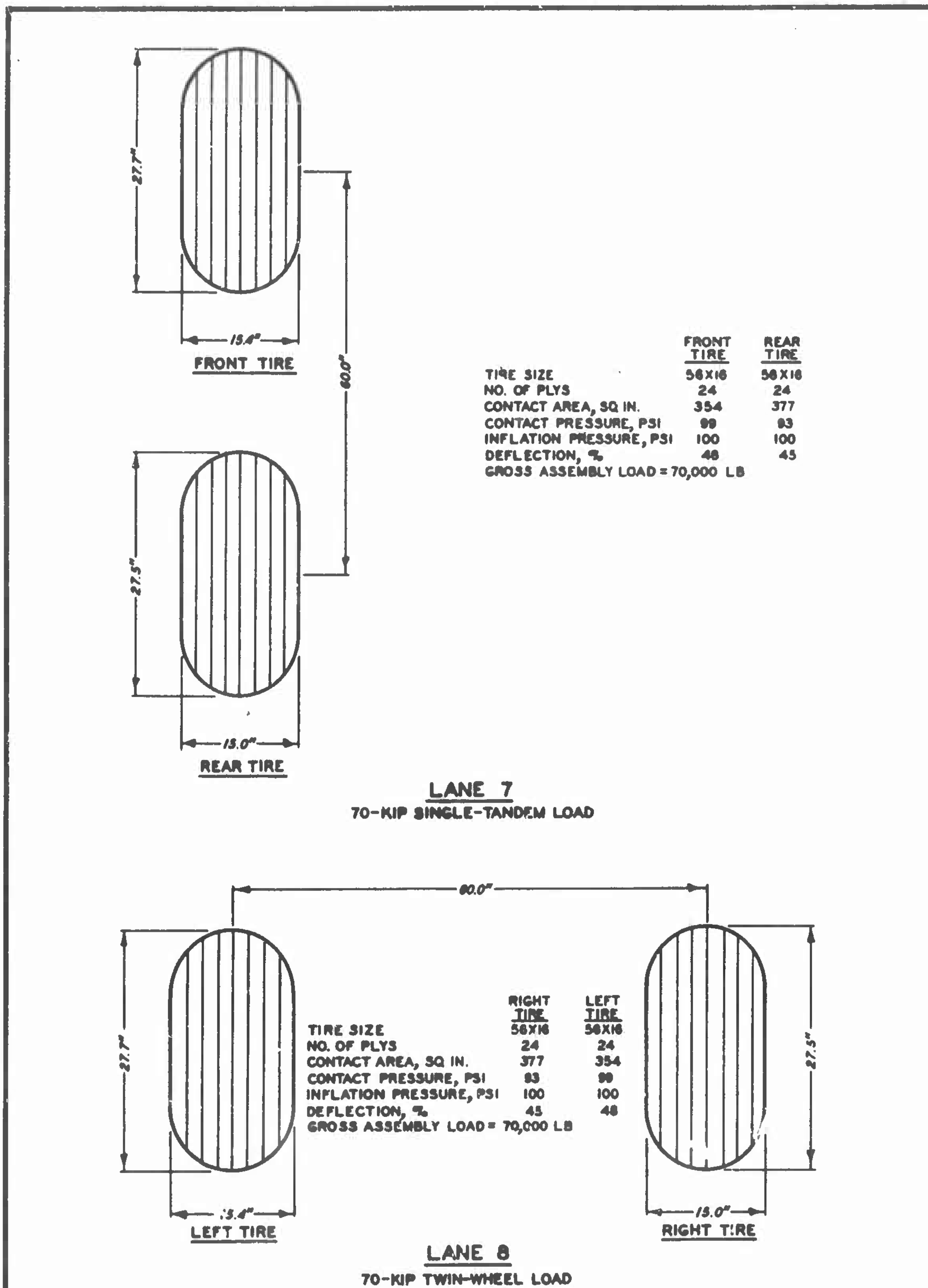
56X16, 24-PLY TIRES
100-PSI INFLATION PRESSURE

Fig 20



LAYOUT OF
SURFACED ITEMS
TEST SECTION 4
LANES 7 AND 8

Fig 21



Lane 7

	FRONT TIRE	REAR TIRE
TIRE SIZE	56X16	56X16
NO. OF PLYS	24	24
CONTACT AREA, SQ IN.	354	377
CONTACT PRESSURE, PSI	99	93
INFLATION PRESSURE, PSI	100	100
DEFLECTION, %	48	45

GROSS ASSEMBLY LOAD = 70,000 LB

Lane 8

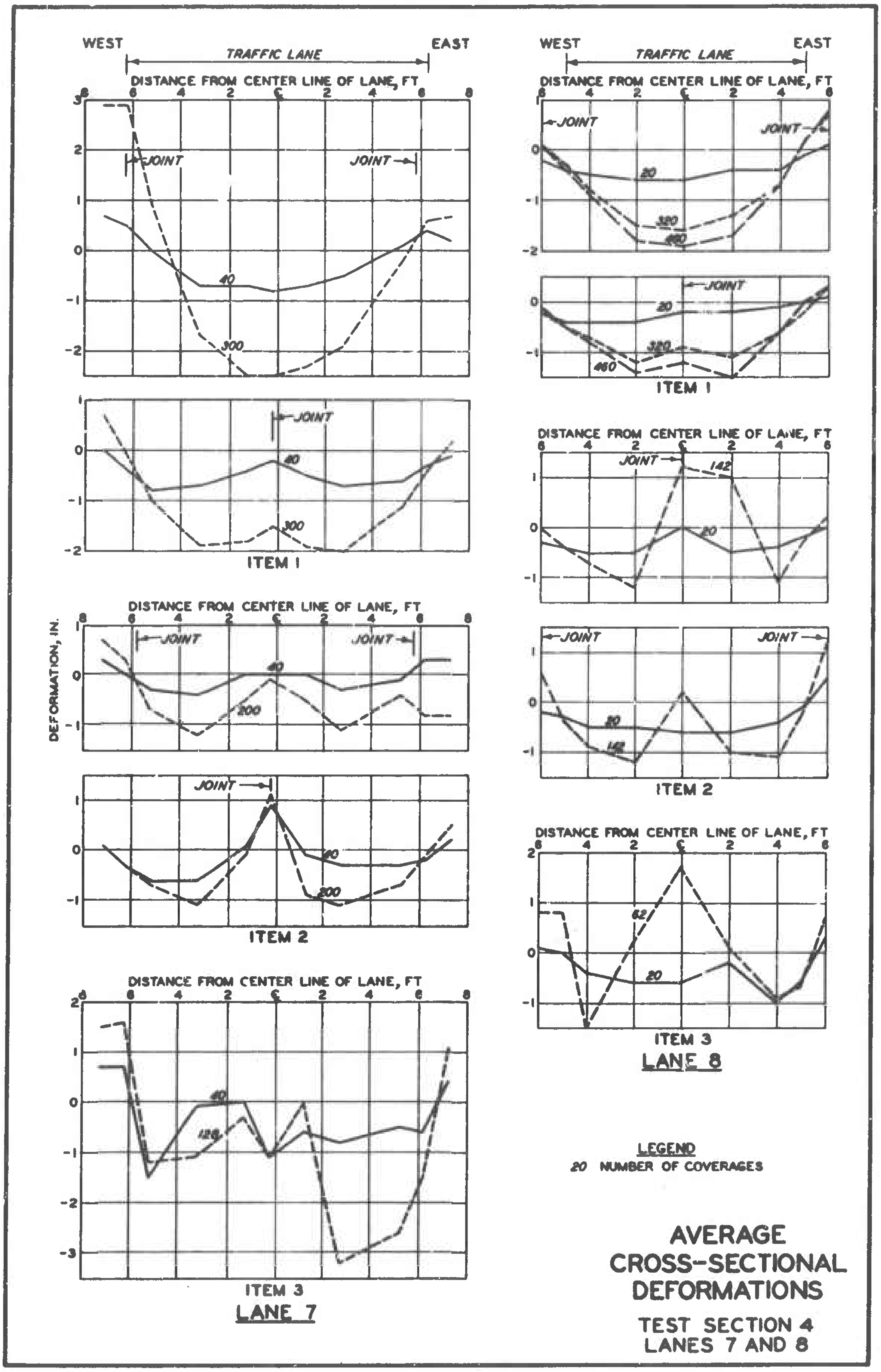
	RIGHT TIRE	LEFT TIRE
TIRE SIZE	56X16	56X16
NO. OF PLYS	24	24
CONTACT AREA, SQ IN.	377	354
CONTACT PRESSURE, PSI	93	99
INFLATION PRESSURE, PSI	100	100
DEFLECTION, %	45	48

GROSS ASSEMBLY LOAD = 70,000 LB

TIRE-PRINT DIMENSIONS AND TIRE CHARACTERISTICS

TEST SECTION 4
LANES 7 AND 8

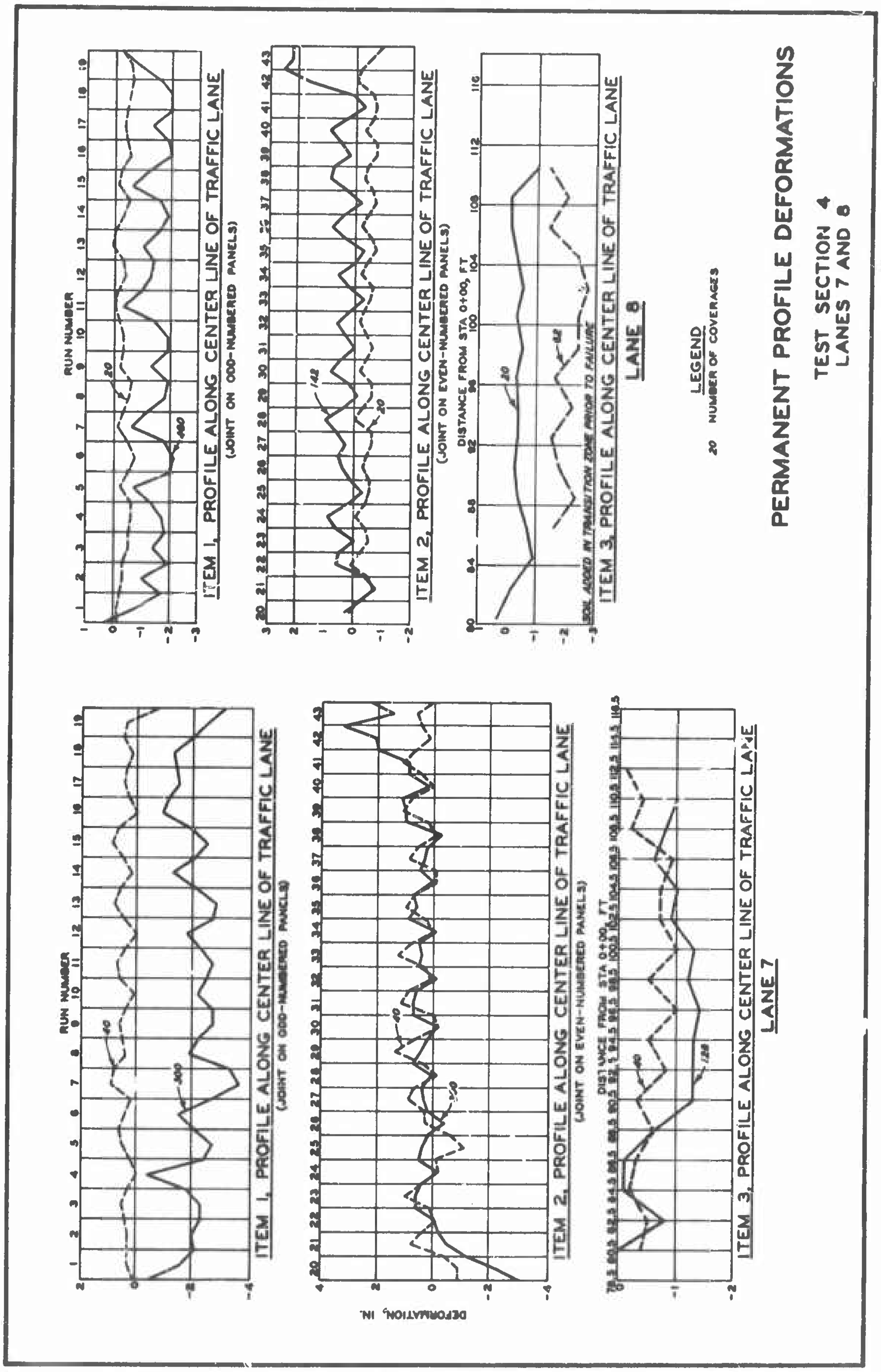
Fig 22



AVERAGE CROSS-SECTIONAL DEFORMATIONS

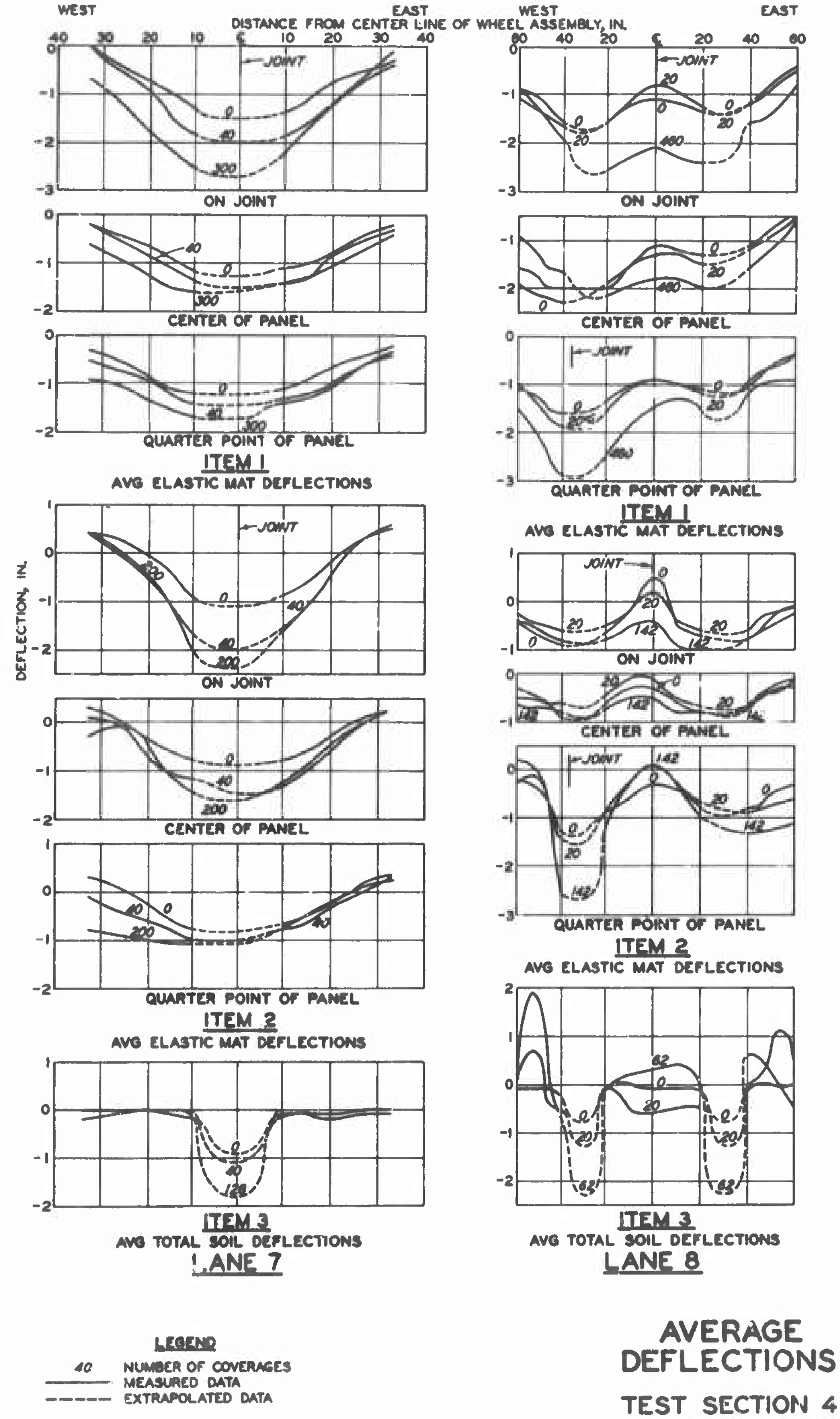
TEST SECTION 4
LANES 7 AND 8

Fig 23



PERMANENT PROFILE DEFORMATIONS
TEST SECTION 4
LANES 7 AND 8
LANE 7
LANE 8
ITEM 1, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
(JOINT ON ODD-NUMBERED PANELS)
ITEM 2, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
(JOINT ON EVEN-NUMBERED PANELS)
ITEM 3, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
RUN NUMBER
DISTANCE FROM STA 0+00, FT
DEFORMATION, IN.
SOIL ADDED IN TRANSITION ZONE PRIOR TO FAILURE
LEGEND
20 NUMBER OF COVERAGES

Fig. 24



AVERAGE DEFLECTIONS

TEST SECTION 4
LANES 7 AND 8

Fig. 25

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This data report describes the results of work undertaken as part of an overall program to develop ground-flotation criteria for the C-5A aircraft.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Aircraft Ground Flotation Rolling Resistance Rear Area Airfields Support Area Airfields Forward Area Airfields Vehicle Mobility						

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